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Coupled Hydro-Geomechanical Modeling of Oil Reservoir Considering Non-Newtonian Fluid through a Fracture

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Abstract : Oil has been used as a source of energy and supply to make materials, such as asphalt or rubber for many years. This is the reason why new technologies have been implemented through time. However, research still needs to continue increasing due to new challenges engineers face every day, just like unconventional reservoirs. Various numerical methodologies have been applied in petroleum engineering as tools in order to optimize the production of reservoirs before drilling a wellbore, although not all of these have the same efficiency when talking about studying fracture propagation. Analytical methods like those based on linear elastic fractures mechanics fail to give a reasonable prediction when simulating fracture propagation in ductile materials whereas numerical methods based on the cohesive zone method (CZM) allow to represent the elastoplastic behavior in a reservoir based on a constitutive model; therefore, predictions in terms of displacements and pressure will be more reliable. In this work, a hydro-geomechanical coupled model of horizontal wells in fractured rock was developed using ABAQUS; both extended element method and cohesive elements were used to represent predefined fractures in a model (2-D). A power law for representing the rheological behavior of fluid (shear-thinning, power index <1) through fractures and leak-off rate permeating to the matrix was considered. Results have been showed in terms of aperture and length of the fracture, pressure within fracture and fluid loss. It was showed a high infiltration rate to the matrix as power index decreases. A sensitivity analysis is conclusively performed to identify the most influential factor of fluid loss.

Keywords : fracture, hydro-geomechanical model, non-Newtonian fluid, numerical analysis, sensitivity analysis
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